

NOVEMBER/DECEMBER 2025

CCA33 — OPERATIONS RESEARCH

Time : Three hours

Maximum : 75 marks

SECTION A — (10 × 2 = 20 marks)

Answer ALL questions.

1. Define Slack Variable.
2. What is meant by an Optimum Solution?
3. Differentiate between Assignment Problem and Transportation Problem.
4. Write the types of Transportation Problem.
5. Give the definition of Sequencing Model.
6. State the notations used regarding Sequencing Models.
7. Enlist the Rules of Network Construction.



8. What is a Dummy Activity?
9. State one field where the Maximal Flow Problem is applicable.
10. What is the Minimal Spanning Tree problem?

SECTION B — (5 × 5 = 25 marks)

Answer ALL questions.

11. (a) Solve the given linear Programming problem graphically:

Maximize:  $Z = 8x + y$ , Subject to:

$$x + y \leq 40$$

$$2x - y \leq 60$$

$$x \geq 0, y \geq 0$$

Or

- (b) Solve the problem Using simplex method:

Maximize  $P = 30x_1 + 40x_2$

Subject to  $2x_1 + x_2 \leq 10$

$$x_1 + x_2 \leq 7$$

$$x_1 + 2x_2 \leq 12$$

$$x_1, x_2 \geq 0$$

18. Find the sequence that minimizes the total elapsed time required to complete the following tasks :

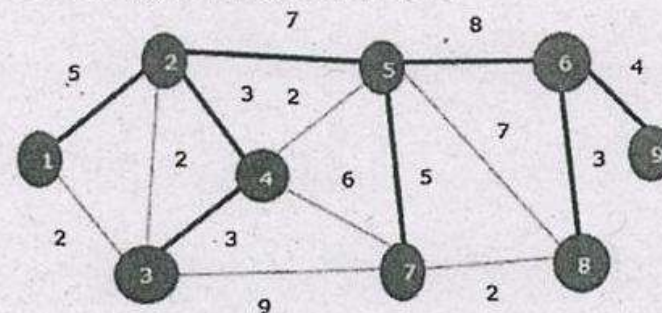
| Tasks               | A | B | C | D  | E | F | G  |
|---------------------|---|---|---|----|---|---|----|
| Time on machine I   | 3 | 8 | 7 | 4  | 9 | 8 | 7  |
| Time on machine II  | 4 | 3 | 2 | 5  | 1 | 4 | 3  |
| Time on machine III | 6 | 7 | 5 | 11 | 5 | 6 | 12 |

19. A small maintenance project consists of the following jobs whose precedence relationships is given below :

| Job             | 1-2 | 1-3 | 2-3 | 2-5 | 3-4 | 3-6 | 4-5 | 4-6 | 5-6 | 6-7 |
|-----------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Duration (days) | 15  | 15  | 3   | 5   | 8   | 12  | 1   | 14  | 3   | 14  |

- (a) Draw an arrow diagram representing the project.
- (b) Find the total float for each activity.
- (c) Find the critical path and the total project duration.

20. Find the Minimum Spanning Tree of the following from point 1 to 9.





SECTION C — ( $3 \times 10 = 30$  marks)

Answer any THREE questions.

16. Solve the following linear programming problem using Big-M method.

$$\text{Maximize } Z = 12x_1 + 15x_2 + 9x_3$$

Subject to:

$$8x_1 + 16x_2 + 12x_3 \leq 250$$

$$4x_1 + 8x_2 + 10x_3 \geq 80$$

$$7x_1 + 9x_2 + 8x_3 = 105$$

$$x_1, x_2, x_3 \geq 0$$

17. Consider the problem of assigning five jobs to five persons. The assignment costs are given as follows. Determine the optimum assignment schedule

|        |   | Job |   |   |   |   |
|--------|---|-----|---|---|---|---|
|        |   | 1   | 2 | 3 | 4 | 5 |
| Person | A | 8   | 4 | 2 | 6 | 1 |
|        | B | 0   | 9 | 5 | 5 | 4 |
|        | C | 3   | 8 | 9 | 2 | 6 |
|        | D | 4   | 3 | 1 | 0 | 3 |
|        | E | 9   | 5 | 8 | 9 | 5 |

12. (a) Solve the given problem by VAM method and test the optimality of the problem by MODI method.

|        |        | Destination |     |    |        |
|--------|--------|-------------|-----|----|--------|
|        |        | D1          | D2  | D3 | Supply |
| Source | 01     | 4           | 8   | 8  | 76     |
|        | 02     | 16          | 24  | 16 | 82     |
|        | 03     | 8           | 16  | 24 | 77     |
|        | Demand | 72          | 102 | 41 |        |

Or

- (b) Three jobs A, B and C one to be assigned to three machines U, V and W. The Processing cost for each job machine combination is shown in the matrix given below. Determine the allocation that minimizes the overall processing cost.

|     |   | Machine |    |    |
|-----|---|---------|----|----|
|     |   | U       | V  | W  |
| Job | A | 17      | 25 | 16 |
|     | B | 10      | 25 | 16 |
|     | C | 12      | 14 | 11 |

(Cost is in Rs. per unit)



13. (a) Find the sequence that minimizes the total elapsed time (in hours) required to complete the following tasks on two machines :

| Task       | A | B | C | D | E | F | G | H | I  |
|------------|---|---|---|---|---|---|---|---|----|
| Machine I  | 2 | 5 | 4 | 9 | 6 | 8 | 7 | 5 | 4  |
| Machine II | 6 | 8 | 7 | 4 | 3 | 9 | 3 | 8 | 11 |

Or

- (b) We have seven jobs, each of which has to go through the machines M1 and M2 in the order M1 M2. Processing time (in hours) are given as :

| Job | 1 | 2  | 3  | 4 | 5  | 6  | 7 |
|-----|---|----|----|---|----|----|---|
| M1  | 3 | 12 | 15 | 6 | 10 | 11 | 9 |
| M2  | 8 | 10 | 10 | 6 | 12 | 1  | 3 |

Determine a sequence of these jobs that will minimize the total elapsed time.

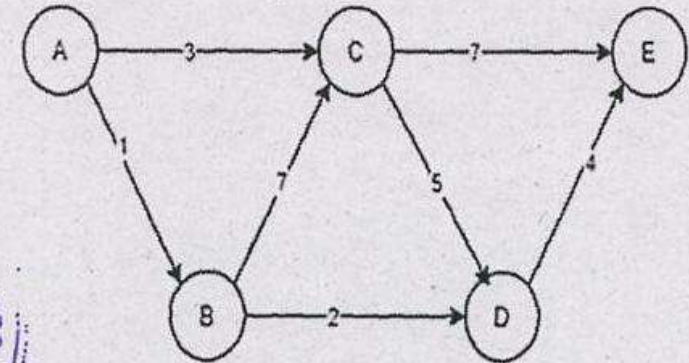
14. (a) Construct a network of the project whose activities are given as below :

$A < C, D, I; B < G, F; D < G, F; F < H, K;$   
 $G, H < J, I, J, K < E$

Or

- (b) Enumerate the comparison and limitations of PERT and CPM.

15. (a) Find the shortest path in the given graph from point A to E.



Or

- (b) Find the Max flow for the given graph G from the source S to destination T.

